GETTING THE MOST OUT OF RDS

by Alan Jurison

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GETTING THE MOST OUT OF RDS

CHAPTER 1 - WHAT YOU NEED TO KNOW

Recent developments have renewed interest in RDS support among broadcasters. I've worked with countless engineers, general managers and program directors when implementing RDS and would like to share some of my knowledge to help you understand how the technology works and how to optimize it for your station(s).

The European Broadcasting Union designed the Radio Data System in the 1980s to provide information, such as the station name and what's currently airing, to FM radio displays. This standard was improved over the years and later adopted within the United States in 1992, with slight modifications, by the National Radio Systems Committee. This variation from the European version is called Radio Broadcast Data System, or RBDS. Because the concepts I am discussing often are interchangeable between the European and American standards, I will refer to these standards collectively as RDS.

Earlier in this decade, major U.S. automobile manufacturers started including RDS on many factory-installed radios. In the past few years, automakers have improved on these early designs with newer radios that include multi-colored, larger display touch screens for configuration, GPS navigation and even viewing of DVDs or other videos. Luckily, they've been able to improve the RDS experience as well.

Within the past six months, the Insignia NS-HD001, Microsoft Zune HD and Apple's iPod fifth-generation Nano, portable receivers with RDS support have entered the marketplace. The NRSC also has revived its RDBS subcommittee, as stations express a renewed interest in RDS.

'MyGig Navigation Radio' is an optional feature included on many of the higher-end Chrysler models. Shown is model RER, included in a 2008 Jeep Grand Cherokee Limited.

With this document, we'll try to provide "best practices." They might vary depending on your implementation, experiences and opinions, so please don't consider them as things you "have to do," but take them as suggestions. Please give me your feedback as we go along to alan.jurison@citcomm.com.

The RDS/RBDS standard documents are lengthy, technical documents that are not easy to read. Luckily for us, we don't need to know many of these details because RDS hardware/software vendors created products that handle most of the details already.

However, there are some basic things to know. The standard has two fields that are arguably the "most visible" as far as the listener is concerned. These are the PS (Program Service) and RT (Radio Text).

PS (Program Service)
The PS is an eight-character field designed in the initial RDS/RBDS standards to describe the radio station and remain static.

Many early RDS receivers only showed this field prominently on the display, featuring no other information. Over time, the use of the PS has evolved into a dynamic "scrolling" or "framed" display. Against the intention of the original standards, most stations in the United States now frequently change the text of what is in the PS field.

Instead of leaving the PS with a fixed value of the station name, stations started interleaving the station name and song artist and title, advertisements, promotional and other messages within the PS.

Because the field is limited eight characters, many of the messages stations want to display don't fit in such a small space, so RDS hardware and software vendors have developed solutions to take a long string of text — such as "93Q The #1 Hit Music Station Fireflies Owl City" — and chop it into the PS eight characters at a time, with time delays, creating the scrolling effect.

Since many radios prominently display PS when a user tunes to the station, this practice ended up being the best way to get the majority of radios with RDS support to display a variety of messages.

This "evolution" of PS hasn't come without controversy; many have argued that it violates the written RDS/RBDS standards. Others are concerned that changing the display of a mobile receiver can be distracting to a driver. My goal in describing this is not to renew the controversy but to inform you as to the current state of the PS. Simply, most stations in the United States are employing some sort of scrolling or framing technique.

RT (Radio Text)
RT is a 64-character field designed in the initial RDS/RBDS standards to be used as either a static or dynamic display.

For stations that don't have their automation systems updating their RDS encoders, this often is a basic static message with the station name and a short promotional message. Stations that have employed hardware and/or software solutions to get their automation systems to interface with the Radio Text may make this field dynamic, with a combination of the station name, song title/artist, advertisement/promotional messages, etc.

The problem is that receiver support for RT varies widely. Some receivers never supported this field. Those that did didn't prominently display the RT.

On many receivers that support RT, you have to press a button in order to access this field. Also, since older designs didn't always display all 64 characters simultaneously, the user often had to press the button several times to see the display, or the receiver itself would "scroll" the data across the display.

Luckily, newer automotive and portable players are starting to support the natural display of the RT, all the time, without additional intervention from the user. As receiver designs have improved and used higher-quality displays, they now have the ability to display most if not all of the RT all the time to the user.

Confusion Between PS and RT
Because PS and RT are different fields in the RDS standards, they are treated differently by each receiver. I can't tell you how many times I've talked to someone in the radio industry who gets these two fields confused. Often, this confusion involves the receiver the person is using.

Take the Denon TU-1500RD, a popular tuner used to monitor RDS data. The LED display doesn't support a full 64 characters, so the receiver scrolls the RT on the display to make it fit. Many people confuse this with the PS scrolling or framing.

While the general listening public doesn't necessarily need to know what they're looking at, we in radio need to pay attention and understand how both fields relate to the user experience. I encourage you to try a variety of RDS-enabled radios to understand the user experiences listeners have.

GETTING THE MOST OUT OF RDS

CHAPTER 1 - WHAT YOU NEED TO KNOW

It's important to know that there are newer radios that support RT equally as well as, if not better than, PS. While so much emphasis in the industry has been on the PS and its scrolling/framing effects, we need to be equally as aware of the RT. Ignoring the RT is ignoring the user experience for listeners on newer devices. This is the future of radio displays.

The photo shows one of the newer installed automotive receivers on the market, made by Chrysler. This device, the "MyGig Navigation Radio," is an optional feature included on many of the higher-end Chrysler models.

The company has several versions of this concept. Shown is model RER, included in a 2008 Jeep Grand Cherokee Limited.

Notice the huge open space on the right side where the RT is displayed prominently. Once you've tuned to the station, your eye immediately is drawn to this area of the screen. In fact, with a display like this, you ignore the PS, which is displayed in a less prominent area under the frequency. The PS in this figure is "93Q," but this station uses a scrolling/framing PS display; over time the PS will show the song title and artist, too.

However, it is much more listener-friendly to show the entire RT immediately. I predict we are going to see more receivers that display the RT in a prominent way. The industry needs to make sure we're placing as much value on the RT as we have with the PS in the past.

I've come across stations that are doing PS scrolling/framing and aren't doing RT at all. If your station is in this situation, you should consider adding RT support for the reasons I've mentioned.

Next chapter, I'll discuss the RT Send Rate and Optimization.

GETTING THE MOST OUT OF RDS

CHAPTER 2 - OPTIMIZE RADIOTEXT SEND RATE

In the previous chapter I outlined the history of RDS/RBDS and the differences between the 64-character RadioText and eight-character Program Service. Let's go in-depth on how you can optimize them for your stations.

With the renewed importance of RadioText (RT), you should evaluate your RT send rate.

Most RDS encoders allow an engineer to adjust how frequently the RT is sent in comparison to other RDS data groups. The manufacturer's default settings are not necessarily ideal for a good end-user experience, so they require your attention.

When we tune to a station with RDS and RT, the receiver looks at the RDS signal and starts decoding. Often, it waits until the RT has been sent twice, to make sure it was received without any errors, before displaying it. If your station isn't sending RT frequently, this process can take too long.

This 2010 Buick Lacrosse 'Audio System with Navigation' Package features AM/FM/XM stereo, CD/DVD player, 40 GB hard drive device, MP3 playback, hard-drive-based navigation and rearview camera system. The text display is RDS. Photo by Alan Jurison

RDS encoders often arrive from the manufacturer with a very slow setting. For example, the default on one popular model is set to send one RT group for every four PS groups. With a default setting such as this, the receiver takes up to 15 seconds to decode the RT under optimal conditions. Add in some signal impairments such as multipath or a weak signal, and this process can take even longer.

This creates a bad user experience. Now add the new RadioText+ tagging standards (to be discussed later in this series) and it's clear that your RT transmission rate is an important component to check and consider adjusting.

I recommend increasing the RT transmission rate from the defaults to increase how frequently the RT is sent. The more frequently it is sent, the quicker a receiver can decode and display it to your listeners. Using the example above, instead of one RT group for every four PS groups, I'd recommend sending three RT for one PS.

RT Transmission Rates

RT transmission rates didn't matter much when the RT was mostly hidden on capable mobile receivers. If it took 15–20 seconds to resolve, it wasn't a big deal.

Now it matters more; and I believe we as an industry need to be more aggressive in our RT transmission rates.

This is even more important when it comes to new portable RDS receivers on the market that display the RT prominently. They also are more likely to be operating at lower signal levels due to antenna design, just like using a headphone cable instead of a better antenna, and are more likely to be used in areas with multipath or other signal impairments, such as inside buildings.

Before adjusting your RT send rates, understand what you're doing. By increasing the rate you're making a tradeoff on other RDS functions.

GETTING THE MOST OUT OF RDS

CHAPTER 2 - OPTIMIZE RADIOTEXT SEND RATE

The RDS standard is a very slow data stream, under 1,200 bits per second, and there is a limit on how many bits can be sent every second.

When you increase the RT rate, whatever else you are doing with your RDS may suffer because fewer bits will be available for these functions. The PS will be sent less frequently; accordingly, you should make time delay adjustments to the "scrolling" or dynamic PS to maintain a good user experience. I'll have more on that in the next article in the series.

If your station uses other RDS "specialized" features contained in the Open Data Application (ODA) groups such as Traffic Message Channel (TMC), you may want to consult with your corporate engineering staff or the vendor with whom you have an agreement to make sure the settings you change don't affect these services.

You may need to reduce RT sending rates from my recommendations as a compromise between a better RT experience for the listener and making sure you are meeting ODA obligations.

Encoder-specific Recommendations
I've developed a recommended RT sending rate based on my own in-field testing with various RDS receivers on the market.

My benchmark for developing these recommended settings was to get the RT to display, in optimal reception conditions, in three to four seconds after you've tuned to the station, or after it has been changed, for example when a new song or program element has come on. See my encoder-specific recommendations in the accompanying chart.

Some may consider these settings too aggressive, but I think the industry needs to make an aggressive improvement overall in its RT sending rates to give a good user experience. Remember, three to four seconds is the optimal experience.

Under bad signal conditions, the radio will take longer to display the RT. Even with these recommended RT settings, under poor reception conditions, RT can take 10 or more seconds to display.

If you left the RT send rates at the typical factory default, in those conditions your receiver may take 30 or more seconds to display the RT or perhaps never resolve the RT.

To combat display problems on legacy receivers, some RDS encoders give you the option to always send 64 characters in the RT. If you send something under 64 characters, the encoder adds spaces to the RT.

Encoder Type(s)	Recommended Setting
Inovonics 711/Audemat FMB1, FMB10	RT_RATE=1
Inovonics 712/713/720/730	DRTS=9
Audemat FMB80 / Burk RDS Master/ BW Broadcast RDS3	GS=0A,2A,2A,2A,2A,4A
Pira 32	GPRSEQ=0222

Recommended RadioText (RT) Send Rates for several popular models of encoder. Note that these settings may interfere with special ODA groups you may be transmitting such as leased traffic or other data. If you transmit such data, consult your corporate engineering staff or the company leasing the data from you to ensure you do not interfere with these services.

It is my experience that few if any receivers on the market need this option; if your encoder has this ability, I would turn it off. The longer the RT, the longer it takes to transmit to the receivers.

By always transmitting 64 characters, you will always have maximum delay. Most receivers do not display the RT data until it's been fully received without errors twice. If the RT contains less than 64 characters, you're slowing the process of displaying RT data to the receiver unnecessarily.

Unfortunately, with some legacy encoders, you cannot turn off this option.

I hope you're enjoying this series. Feel free to comment while we go along. My e-mail is alan.jurison@citcomm.com. Maybe you have settings you like better, or other findings regarding RDS.

In the next chapter we'll discuss optimizing dynamic PS scrolling displays.

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CHAPTER 3 - OPTIMIZE PS SCROLL

In this chapter I'm going to focus on optimizing Program Service name scrolling on your stations.

As we've discussed, many stations in the United States employ PS "scrolling," "framing" or "dynamic PS," changing the text over time in the eight-character PS field. In April, when we talked about RDS/RBDS RadioText send rate optimization, I suggested an RT adjustment. Even before that adjustment, you might have found your station dropping the eight-character PS frames periodically.

I've found that a lot of stations have this scrolling delay set way too low. Text scrolls too quickly and, if the receiver has impairments such as multipath, you may drop these frames. With typical RDS encoder defaults, anyone running a delay on their PS at under 2 seconds already was prone to this dropping phenomenon.

I can't tell you how many times I've seen dropped PS packets because the station had its dynamic PS scrolling delays set too low. Often the demand to "make it faster" comes from a PD or GM who is looking at the radio in his or her car, near the studio, in optimal receiving conditions. They get frustrated that the song information, station name etc. aren't scrolling fast enough.

To a point, that's understandable. We're often trying to display something that's 50–100 characters long, eight characters at a time, with a delay in between. By decreasing the delay, and making the scroll go faster, it looks great in optimal conditions.

But then get in the car and drive around and you'll quickly find that you're jumping frames as the receiver runs into multipath and other impairments. This isn't a great user experience. You need to be mindful not to set your delay too low.

If you've followed my recommendations for an aggressive RT sending rate, you'll find that the receivers that prominently display the PS may start dropping frames, perhaps even under optimal conditions. This drop is due to the data rate limitations of the RDS standard.

Minimum Delay
Given this, I would recommend a minimum delay of 3.75 seconds to 4.0 seconds between frames. If your station is more multipath-prone, you might want to make the delay closer to 5.0 seconds.

At first, this delay might drive your GM or PD crazy. After all, they might have thought 2 seconds was too slow. But again, I maintain that we need to fine-tune or "tweak" our RDS implementations so it provides a good experience for all receivers, not just in the PD's car in the station parking lot. It might take some explaining for this concept to get this point across.

Feel free to fine-tune these settings as you deem appropriate for your situation. Some people may feel my recommendations are almost too aggressive.

Or perhaps your station has an Open Data Application agreement and can't dedicate that much data to RT because you're leasing out your RDS carrier for traffic data. Or maybe you feel that a delay of 4 seconds on the PS is just too long.

For those situations, I'd recommend that you find a "middle ground" compromise. For example, on the Inovonics line of encoders, perhaps you change the DRTS=8 and change your PS delay to 3.5 seconds to back off the aggressive nature of the RT. While I don't recommend this setting because the RT will take longer to send, you might like it better.

Luckily, the RDS standards are flexible to allow you to have a variety of parameters you can customize for your situation.

GETTING THE MOST OUT OF RDS

CHAPTER 4 - INJECTION & PILOT SYNCHRONIZATION

In this chapter I'm going to focus on RDS injection rate and pilot synchronization.

RDS runs as a small 57 kHz digital data subcarrier on your FM station. When installing your RDS encoder, you have options to control its overall output level.

This level, often compared in percentage to the overall modulation of the FM carrier, is called the RDS injection level. The National Radio Systems Committee and European RBDS/RDS standards don't actually specify a recommended level.

The standards documents show a nominal value of 3 percent to 11 percent injection but they shy from coming up with a "recommended" value. I have looked at the injection levels used by many different stations across the country, and I've seen many values; I've seen them below 3 percent and above 11 percent. I would say that the typical value has been 4 to 5 percent; and in the past I set my own encoders in this range.

However, with the newer, portable radios, it has been my experience that 4 to 5 percent just isn't enough for solid RDS performance. At this point I would recommend 6 percent. This is a good benchmark to aim for, in my opinion.

Optimal Performance
The iPod Nano's 5th and 6th generations as well as Insignia NS-HD01 and NS-HD02 receivers perform nicely with 6 percent injection. Anything lower than 6 percent on the portable units results in performance that is less than optimal. As an added benefit, 6 percent really makes RDS reception solid in mobile environments, even in multipath; and I've noticed RDS performs much better on the edge of your coverage area at 6 percent injection rather than at 4 or 5 percent.

In my testing with Microsoft's Zune HD, I found that the analog portion of the FM tuner has issues with injection rates below 5 percent, even in optimal reception conditions. Often, I had to increase the RDS injection rate to 7 to 8 percent to get the same RDS performance as the legacy Zune and Apple's Nano can do with 5 to 6 percent.

I noticed that stations with injection below 5 percent typically don't even show on the Zune HD. I performed these tests with multiple Zune HD models, with the factory-installed software and even upgraded to the latest versions.

I presented these observations to Microsoft in the fall of 2009; they acknowledged the issue, but so far they have not dedicated resources towards changing this. While it appears 7 to 8 percent is best for the Zune HD, I personally feel that this injection rate is far more than what should be necessary, seeing how every other radio I've worked with does well in the 4 to 6 percent range.

Also note, this issue with the Zune HD isn't relevant if your station is running HD, as the HD PAD data will be used instead of analog RDS. But with only about 1,600 FMs authorized by the FCC for HD operation, that leaves this problem applicable to approximately 8,150 analog FMs should they elect to encode for RDS. (The figures are as of Sept. 30, 2010, the latest available from the commission.)

When setting your injection level, I feel that it's best done with a modulation monitor that supports RDS injection rates. Often, I've run across stations that didn't have the right measurement equipment when setting this up, and they have no idea what their injection rate actually is.

I've seen RDS injection rates below 3 percent, where it fails to register on most receivers. I've also seen it well over 10 percent, which is unnecessary and, assuming that you're keeping your station's total modulation within FCC limits, robbing you of main channel modulation, which can affect loudness.

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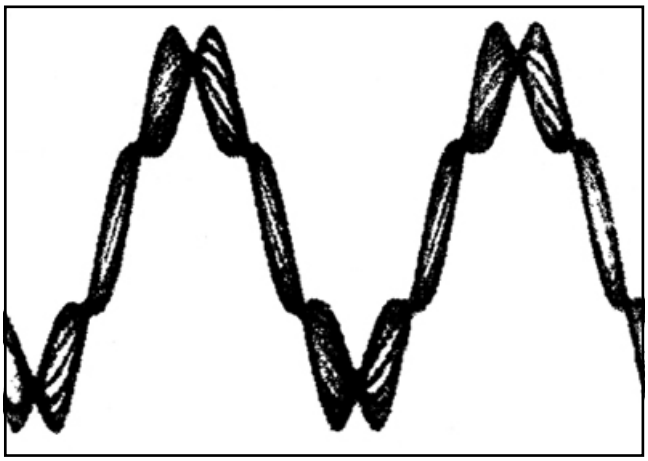
CHAPTER 4 - INJECTION & PILOT SYNCHRONIZATION

Be Precise
It's important to be precise about your modulation and injection rates, so make sure you have the proper test equipment. For those stations that don't have this equipment in-house, see if you can borrow it from a sister station, or buy lunch for a colleague who has access to the gear.

Precision is worth the effort. You should revisit your injection rate if you didn't do this when you deployed an RDS encoder on your station.

Likewise, if you make any changes to your system such as adding or replacing an STL, exciter, RDS encoder, audio processor or other Subsidiary Communications Authorization generators, revisit your RDS injection and other modulation parameters.

Be sure to follow the instructions for your RDS encoder to synchronize and align the RDS signal with the 19 kHz pilot. I've seen stations that don't have their encoders synchronized, and this has caused issues with RDS reception.



An example from the Inovonics 730 user manual of a properly synchronized RDS subcarrier with the pilot, as shown from an oscilloscope. This step can get overlooked when you're installing an encoder.

Also, keep an eye on the sync status of your RDS encoder; some encoders call this "free run" when it is not synced. On some units the synch status is displayed as an indicator on the front panel. On other encoders, this is done using software, such as a computer program, serial/telnet commands or Web configuration.

Watch this over time to make sure you're always synced. I've run into situations where an encoder was going in and out of sync and it turned out the input level of the 19 kHz sample wasn't sufficient.

When the encoder was going in and out of sync, it would cause RDS reception errors, creating a bad user experience of delayed RadioText reception and skipped Program Service scrolling frames. The added benefit of this process is that a properly synced RDS encoder in quadrature will reduce slightly the modulation peaks of the subcarrier without reducing their actual levels, giving you more room for your main channel modulation.

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CHAPTER 5 - RADIOTEXT PLUS HOLDS PROMISE

If you've been following the industry news in the past two years, you probably have heard of RadioText Plus, RTplus and "RT+ Tagging." It's a technical name, but I think the concept holds great promise for the broadcasting industry.

RT+ is an additive data stream you can add to your RDS encoding that identifies the text that you are encoding in your RadioText (RT). Remember, as we discussed in the second article of this series, the RT is a 64-character description that you can change anytime.

The RT frequently is used to display the station name, promotional/advertisement messages, program data and song title/artist/album data. Until the RT+ standard was developed, there was no way to know what that data was from a hardware standpoint, and this is important for song tagging.

There are multiple forms of "tagging" on the market these days. There are proprietary versions of song tagging for both RDS/RBDS on analog FM and iBiquity's HD Radio.

These types of tagging identify song information, unique song identifiers and unique "affiliate" identifiers to allow a radio station to get paid for a song that's downloaded. While these systems generally cost money to license and implement, RT+ is a free, open source tagging standard that allows you to tag song information and a whole host of other items of interest that a radio might display via RDS.

Fig. 1: Zune HD showing RT+ tags. Photo by Alan Jurison

Bridging The Gap
Let's take the following example of a possible RT:

93Q – Fireflies – OWL CITY – CD: Ocean Eyes

A human can look at the RT, see that it is a song title/artist/album, get a paper and pen, write it down and later search for this song. However, to do this electronically is more difficult. Sure, the receiver can save the RT. But when the time comes to download the song later, the unit wouldn't know which part of that line was the artist or the title.

The receiver might confuse the station's name or other items in the RT. In the example, what's the title of the song? 93Q? Fireflies? Owl City? The receiver doesn't know; and that's where RT+ becomes valuable.

Because the RT field is so flexible, the receiver can't make any assumptions. RT+ bridges the gap and essentially defines what each part of the RT actually is. It also can give radio stations an "MP3 player feel" by now showing title, artist and album on separate areas of the display, which makes for better readability for the listener.

While we've just started to hear about this standard in the past year in the United States, RT+ is not new. In 2005, a consortium of engineers in Europe designed the RT+ standard, and it's free of charge for use and implementation.

The standard has been improved over time, and in the past few years, several RT+ receivers have come to market in the United States. Microsoft Zune products first supported RT+ with a software upgrade.

Since then, the Microsoft Zune HD supports RT+ for analog only, meaning non-HD Radio stations, and Apple added an FM tuner with RDS and RT+ support in its fifth- and sixth-generation Nano players.

Fig. 2: IPod Nano fifth and sixth generations, showing RT+. Photo by Alan Jurison

Figs. 1 and 2 show Zune HD and iPod Nano using RT+ to parse a song's title/artist/album from the RT. The fifth-generation iPod gives you the ability to "tag" the song for later download by pressing and holding the center button. On the sixth generation you just touch and hold the "tag" icon on the bottom, left-hand portion of the screen.

The next time you connect your Nano to your computer and launch iTunes, you can view your tagged songs and buy them. The Zune HD has an icon at the bottom right-hand side of the screen with a shopping cart; click on that and it's added to your cart.

Because the Zune HD has built-in Wi-Fi (802.11) support, you can actually purchase that song and download it to your Zune HD immediately by going to the "Marketplace" software store from the Zune HD. (Note that the Zune may be on its way out; Microsoft reportedly is set to abandon its player due to poor demand, though that had not been confirmed by the company at this writing.)

The Future

The RT+ standard is future looking.

While today's available receivers in the United States support just artist/title/album tagging, there are some other promising things you can tag.

There are more than 60 content types available for use today. Fig. 3 shows a few I think hold the most promise. If broadcasters start widely tagging for some of these new features, hopefully receiver manufacturers will start supporting them.

Code	RT+ Class	Description
1	Item.Title	Title of the item on the air; i.e. song title
2	Item.Album	Album of item on the air
4	Item.Artist	Artist of the item on the air
29	Info.URL	Link to a URL (web page)
31	Stationname.Short	Short name describing station
32	Stationname.Long	Long name describing station
36	Program.Host	Host of the current radio show
39	Program.HomePage	URL (web page) for radio station home page
41	Phone.Hotline	Telephone number of the radio station's hotline
42	Phone.Studio	Telephone number of the radio station's studio
43	Phone.Other	Other telephone number
44	SMS.Studio	SMS (Text Messaging) number for studio
45	SMS.Other	Other SMS (Text Messaging) number
46	Email.Hotline	Email address of the radio station's hotline
47	Email.Studio	Email address of the radio station's studio
48	Email.Other	Other email address
59	Place	Address information for a location
60	Appointment	Date and time information for an event

Fig. 3: Here are content types from the RT+ standard that the author believes hold the most promise. 'If broadcasters start widely tagging for some of these new features, hopefully receiver manufacturers will start supporting them.'

To see the full list of content types available in the standard, see Annex P, Table P.2, Pages 155–156 of this document: www.rds.org.uk/2010/RDS-Specification.htm. You must request a free password.

Title, artist and album are just the beginning of the things we can tag. Looking at the list available to us, we have the ability today to tag phone numbers, websites, text campaigns, addresses and times and dates. This is what the industry has been dreaming about for years.

Imagine being able to run an advertisement from a client, displaying their name, address, phone number and website. We can now encode these using RDS and RT+.

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CHAPTER 5 - RADIOTEXT PLUS HOLDS PROMISE

As more smart receivers with RDS/RT+ support come to market, it's possible that soon we can have the receiver act on an advertisement. Remember the "dream" of coupon radio? This is better. With the smartphones on the market, it's just a matter of time for someone to integrate a phone with FM tuner and RDS/RT+ support. Then, someone could push a button while an advertisement is running and call the client on the phone, or visit their website, or look up directions to their location.

This concept can be applied to station programming, contests and events. We're right on the cusp of this, and RT+ gives us a great platform to offer exciting interactive services for our listeners and our advertisers.